The Sidereal Messenger.

CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory.

DECEMBER, 1886.

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By faith we understand that the worlds have been framed by the word of God, so that which is seen hath not been made out of things which do appear.

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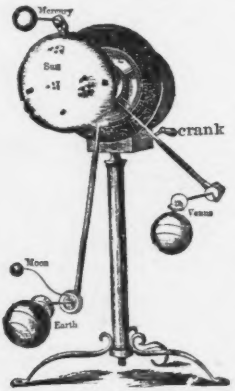

HELIOTELLUS.

When the Earth's axis is pointed to the north, it will continue so pointing throughout the revolution, and will be in the Ecliptic. The Earth rolls over from west to east, and if the Equator be continued to the sky, it will meet the Equinoctial. So with the Ecliptic, if continued, it will come near to the Moon, near to Mercury, near to Venus, and always to the Sun, for the ecliptic plane.

I have now in my possession all the Heliotelluses for sale, made with a set of tools costing $25,000, which tools were afterwards destroyed by fire. They were so accurately made that the Heliotellus cannot now be duplicated for less than $250 each. The greatest impediment I find in their introduction is the Tellurian, which makes a false showing of the heavenly movements. It is a device in which the Earth's axis wabbles around the zenith and never points to the north. This is the greatest bearier to the comprehension of this most sublime of the sciences. The Heliotellus shows so near the truth that it is not hard to comprehend.

In high schools, seminaries, colleges, and all places of learning we find many globes and maps of the earth, but where can one be found having the Equator of the Earth so constructed that if continued it will meet the Equinoctial in the right place on the sky? Every child should have a truthful understanding of science. The Ecliptic should be correctly understood. All instruments which show imperfect teaching are hurtful; those which teach correctly are useful. The one should be rejected, the other sought for, and when found should be prized even as a "pearl of great price." Three hundred such I now possess, all perfectly made, and I now propose to sell two hundred at the reduced price of $20 each, or for $65, the price of one. I will send four, each well packed in a strong box to carry by express anywhere. Address,

HENRY WHITALL,

BELVIDERE SEMINARY, BELVIDERE, N. J.

The Sidereal Messenger,

CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory, Northfield, Minnesota.

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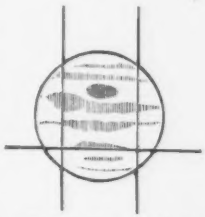
ROTATION TIME OF THE RED-SPOT ON JUPITER.

PROF. C. A. YOUNG.

For the Messenger.

I send herewith a determination of the rotation period of the "red-spot" deduced from the observations obtained at this place during the past opposition. All the observations were made by myself except the first, which was by Prof. McNeill. Numbers 6 and 8 were made with the 9½ inch equatorial; the rest with the 23 inch. The power used ranged from 360 to 500 according to the state of the air. Observation No. 8 was made some minutes before sunset, and naturally the spot was rather difficult to see; still so far as can be judged from the residuals, it appears to have been fairly comparable with the rest in accuracy, and I have let it stand as of equal weight. The observations were made by setting the micrometer wires about 30″ apart, placing them perpendicular to the planet's equator and so as to cut off equal segments of the disc, and then noting when the spot was midway between them, as in the diagram. The times given are eastern standard mean time, *five hours slow* of Greenwich mean time. In most cases the observations were made in local sidereal time, which was subsequently reduced to standard time. In correcting the observations for the planet's motion in longitude, they were reduced to a geocentric longitude of 180°, the slight



inclination of the planet's orbit and equator to the ecliptic being neglected, as its effect would be quite insensible. This longitude correction (in minutes of time)$=0.993m$ [180°—L], taking the rotation period as $9h$ $55.7m$. The observations were also reduced for the light equation to a distance equal to the planet's mean distance from the sun, 5.203. This correction (also in minutes of time),$=8.33m$ [5.203—Δ], assuming $500s$ for the time required by light to traverse the distance unity—from sun to earth.

In the table the first column contains a reference number, the second gives the standard mean time of transit as observed; the columns headed L and Δ give the planet's geocentric longitude and distance from the earth taken from the *Connaisance des Temps*; the column C gives the sum of the corrections to be applied; while T gives the corrected minutes and decimals used in forming the equations of condition. Column N gives the number of rotations elapsed since the transit of March 17th. Finally the last column gives the residual error of each observation, deduced from the least square solution of the equations.

TRANSITS OF JUPITER'S 'RED-SPOT,' 1886, OBSERVED AT PRINCETON.

	Observed Standard Mean Time.			L	Δ	C	T	N	E
		h	m	° ′		m	m		m
1	March 17	11	25.00	181 30	4.458	+3.47	28.47	0	+1.05
2	April 15	10	16.06	178 07	4.542	+8.09	24.06	70	−0.24
3	May 12	7	33.05	176 13	4.817	+9.47	42.52	135	−1.47
4	May 26	9	08.05	176 04	5.010	+8.12	16.17	169	−0.88
5	May 28	10	48.36	176 05	5.039	+7.85	56.21	174	+0.76
6	June 5	7	26.00	176 19	5.160	+6.45	32.45	196	−0.88
7	June 18	9	03.04	177 08	5.376	+3.32	6.96	227	+0.56
8	June 29	7	23.25	178 02	5.532	+0.52	23.77	251	+1.09

EQUATIONS OF CONDITION.

		m	c			m	c
1	$a+$	$0p=$ 0.00	[−1.05]	5	$a+174p=$	−4.06	[−4.82]
2	$a+$	$70p=$ −2.81	[−2.57]	6	$a+193p=$	−6.12	[−5.24]
3	$a+$	$135p=$ −5.45	[−3.98]	7	$a+227p=$	−5.41	[−5.97]
4	$a+$	$169p=$ −5.60	[−4.72]	8	$a+251p=$	−5.40	[−6.49]

Each observation furnishes one equation of condition of the form

$$a+N\,(595.7m+p)=T-T_0$$

in which a is the error of the observation of March 17th; N, the number of rotations since that date; p, the small correc-

tion to 595.7*m*, the assumed period; T, the *corrected* time of transit, and T_0 the corrected transit of March 17th. These equations of condition are given at the foot of the table, and need no explanation, except that the numbers in brackets are the result of substituting the values of a and p found from the solution of the equations: which solution gives

$$a = -1.055m \pm 0.566\,; \quad p = -0.02166m \pm 0.00330.$$

From this we find that the *observed* time (uncorrected) of the transit of March 17th, should have been 16*h* 23*m* 57*s* ± 34*s*, *Greenwich* M. T., while the rotation period is 9*h* 55*m* 40.7*s* ± 0.2*s*.

The probable error of a single observation comes out ± 0.73*m*, or 44*s*: but the number of observations is not sufficient to determine the probable errors with much certainty.

The remarkable retardation of the period of rotation still persists.

In 1879 Mr. Pratt made the period	9	55	34.9
" 1880–81 Mr. Hough	9	55	37.2
" 1882 3 " "	9	55	38.4
" 1883–4 " "	9	55	38.5
" 1884–5 " "	9	55	40.1

Mr. Denning's values for 1882–3–4 are about 1*s* larger than Mr. Hough's, but agree in showing that the period was but slightly retarded during that interval, while the renewed activity of the spot, indicated by its revived color and easier visibility, has been accompanied by a new increase of period.

The spot was faint during the last season, but far more conspicuous than in 1885. At one time (April 15) a prong or wisp from the northern edge of the southern belt seemed to overlie the red spot, encroaching upon it about one fourth of the width of the spot. I say *seemed* to overlie; but it was impossible to say certainly which was uppermost, for the outlines *both of spot and belt*, were visible as if the belt were a semi-transparent cloud through which the form of the spot could be seen; or equally as if the spot were the semi-transparent overlying object. Still my own impression was strong that the spot was underneath. The figure gives an

idea of the appearance. When I next observed it, on May

Red-spot and Surroundings, April 15, 1886. Power, 790.

12th, the belt had drifted to the west, so that the point of bifurcation (*C* in the figure) had moved about to *X*, and the filament seemed to have narrowed so that the encroachment upon the spot, if it still existed, was very slight—too slight to be sure of in the unsteady air of that evening.

On the 26th and 28th there was certainly a clear, bright streak—very narrow, to be sure, surrounding the oval spot completely. The central white shade on the red spot was smaller and less noticeable than in '85. At times it became a mere streak.

Princeton, N. J., Oct. 15, 1886.

P. S.—In the Monthly Notices of the R. A. Soc. for June, 1882, Prof. C. Pritchett publishes an extensive series of observations of the red-spot made during the preceding opposition. He compares them with Marth's ephemeris, but does not appear to have worked out the rotation period corresponding. I have selected 14 of the observations which seem to be the best and the best spaced for the purpose, and have reduced them in the manner indicated above. They give for the rotation period $9^h\ 55^m\ 38.15^s$. The residuals are generally satisfactory, but three of them are between 2 and 3 minutes, showing either some want of extreme accuracy of observation or else *some irregular motion of the spot.*

I have also made a similar reduction of Mr. Pratt's observations in 1879, already referred to, (M. N. R. A. S. Jan. 1880). They give $9^h\ 55^m\ 34.05^s$, and only one of the 12 residuals ex-

ceeds two minutes. This result differs slightly from that deduced by Mr. Pratt himself by a less thorough treatment—33.91*s*.

I may add that the rotation period of a small round white spot which I observed three times in March and April, 1885, over a range of 58 revolutions, comes out 9*h* 55*m* 11.14*s*. The observations are almost absolutely accordant; and it is noteworthy that although this spot was in a higher latitude (about 50° south) than the red-spot, it yet rotates more rapidly.

ASTRONOMY AND THE ICE AGE.

For many years past, search has been diligent, for an explanation of the glacial epochs which are so well marked in the earth's crust that science declares them settled facts in geological history. In the solution of this fundamental problem, the astronomer has been able, so far, to give very little assistance, and that chiefly of a negative kind. Laplace has shown that the secular change in the obliquity of the ecliptic is confined within so narrow limits that no astronomer has regarded this as a cause seriously affecting climate. In itself considered, the precession of the equinoxes can have no influence on the climate. The secular change in the eccentricity of the earth's orbit is the only remaining cause which has generally occupied the attention of astronomers. Lagrange, Leverrier and Stockwell agree fairly well in results obtained for the greatest value of this change, which, in decimal form, does not probably exceed 0.077747, and whose least value is not less than 0.0022, making a possible variation between the upper and lower limits of the eccentricity of the earth's orbit, by these data not so much as one-twelfth of the whole. Now, since the major axis of a planetary orbit is invariable, and consequently the absolute length of the year, it follows, as Herschel said more than fifty years ago, that "The quantity of heat received by the earth from the sun in one revolution is inversely proportional to the minor axis of the orbit." As the eccentricity of the earth's orbit has been diminishing for the last 800,000 years,

its minor axis has been increasing (although very irregularly) and consequently solar radiation diminishing proportionately. Now, if the fluctuation of eccentricity should amount to as much as one-twelfth of the semi-major axis, the variation of the sun's heating power as a whole would not be increased as much as one-half of one per cent. And if it should even amount to one-fourth, as Herschel supposed in 1830, the increase in solar radiation would be only three per cent of the whole. Our smaller fraction of change is nearly the maximum as derived from Leverrier's formulæ for computing the eccentricity of the earth's orbit and published in 1843. As tabulated by Croll, it covers a period of 4,000,000 years.

The very small change in the numerical value of the sun's heating power for the entire surface of the earth, at the known limit of the eccentricity of its orbit, has led astronomers to claim that this cause, though tending in the right direction, was not sufficient to account for the glacial periods of geology.

So far as the writer knows, this view has been held by astronomers generally, and scientists have not questioned it until, in 1875, there appeared a work entitled *Climate and Time*, by James Croll, the purpose of which was to show that the glacial epochs were due indirectly to the secular variation of the eccentricity of the earth's orbit. The tabular data, before referred to, which this book gives, cannot, of course, be accepted as rigorously true in regard to dates of epochs, because the formulæ of Leverrier depend on the solar parallax which was then certainly two per cent. in error. With a solar parallax now possibly one-half of one per cent. wrong, we will find the dates of those ice-age epochs still very uncertain. For example, if a maximum of eccentricity should be declared to have occurred 2,000,000 years ago, by this method of calculation, and the perihelion of the earth's orbit be so placed that the sun would be nearest the earth in northern winter, a condition which Mr. Croll argues might produce a glacial epoch in the southern hemisphere, the probable error of result from uncertain data would make the computed date uncertain by half a million of

years, and therefore the physicist would not certainly know whether to name it an ice or a tropical epoch.

In connection with this interesting theme, attention is called to a note recently published in *Nature*, October 21, 1886, by Dr. R. S. Ball, of Ireland. It is appended in full.

Note on the Astronomical Theory of the Great Ice Age.

The following calculation has convinced me that Mr. Croll's theory affords an adequate explanation of the Ice Age. I compute the total quantity of heat received by each hemisphere of the earth during summer and winter respectively as follows:

Let $\frac{2H}{a^2}$ be the quantity of sun-heat falling perpendicularly on an area equal to the section of the earth at the mean distance a from the sun in the unit of time.

Let δ be the sun's north declination. Then the share received by the northern hemisphere will be

$$\frac{H}{a^2}(1+\sin\delta),$$

and by the southern

$$\frac{H}{a^2}(1-\sin\delta).$$

At the distance r, and in the time dt, the heat received in the northern hemisphere will be

$$\frac{H}{r^2}(1+\sin\delta)\,.\,dt\,;$$

but we have

$$r^2 d\theta = h\,dt,$$

whence the expression becomes

$$\frac{H}{h}(1+\sin\delta)\,.\,d\theta\,;$$

but we have

$$\sin\delta = \sin\theta\,.\,\sin\varepsilon,$$

where ε is the obliquity.

The total heat received by the northern hemisphere from the vernal to the autumnal equinox is the integral between π and 0 of,

$$\frac{H}{h}(1+\sin\varepsilon\sin\theta)\,.\,d\theta = \frac{H}{h}(\pi+2\sin\varepsilon).$$

We have thus the following theorem:

Let $2E$ be the total sun-heat received in a year over the whole earth; then this is divided into shares as follows:

$$\text{Northern hemisphere, summer, } E\frac{\pi+2\sin\varepsilon}{2\pi},$$

$$\text{“ “ winter, } E\frac{\pi-2\sin\varepsilon}{2\pi};$$

with identical expressions for the summer and winter in the southern hemisphere.

If we make $\varepsilon = 23°27'$ we find that the heat received during the summer (equinox to equinox) of each hemisphere is $\cdot 627E$, while the heat during the winter of each hemisphere is $\cdot 373E$. More briefly still. If each hemisphere receives in the year a quantity of sun-heat represented by 365 units, then 229 of these are during summer, and 136 during winter. These figures are independent of the eccentricity of the earth's orbit.

The length of the summer is defined to be the interval when the sun's centre is above the equator. The length will of course vary with the eccentricity and with the position of the equinoxes on the orbit. We need only take the extreme case where the line of equinoxes is perpendicular to the major axis of the orbit. The maximum difference between the length of summer and winter is thus

$$365 \text{ days} \times \text{eccentricity}.$$

I take the maximum eccentricity of the earth's orbit to be

$$0{\cdot}0745,$$

this being the mean of the values by Leverrier, Lagrange and Stockwell (See Croll, “Climate and Time.,” p. 531), and therefore, the greatest difference between summer and winter will be about 33 days, *i. e.* one season in 199 days, and the other in 166 days.

The total quantity of heat received during the year on each hemisphere is practically independent of the eccentricity; but the mode in which that heat is received at the different seasons will vary, and thus give rise to the following extreme cases:

GLACIAL.

(Summer) 229 heat units spread over 166 days.
(Winter) 136 " " 199 "

INTERGLACIAL.

(Summer) 229 heat units spread over 199 days.
(Winter) 136 " " 166 "

We hence deduce the following, where unity represents the mean daily heat for the whole year on one hemisphere :

GLACIAL.

Mean daily sun-heat in summer (short)	...	1·38
" " winter (long)	...	·68

INTERGLACIAL.

Mean daily sun-heat in summer (long)	...	1·16
" " winter (short)	...	·81

PRESENT (NORTHERN HEMISPHERE).

Mean daily sun-heat in summer (186 days)		1·24
" " winter (179 days)	...	·0·75

These figures exhibit a thermal force of great intensity. The unit represents all the mean daily heat received from the sun by which the earth is warmed up from the temperature of space. The heat unit in fact maintains a temperature perhaps 300°, or even more, above what the earth would have without that heat. Each tenth of a unit may thus roughly be said to correspond to a rise or fall of mean temperature of 30° or more. The long winter of 199 days, when the average heat is only two-thirds of a unit, leads to the accumulation of ice and snow, which form the glacial epoch. The short winter of 166 days, where the temperature is ·06 of a unit above that of our present winter, presents the condition necessary for the mild interglacial epoch.

THE SIX INNER SATELLITES OF SATURN.

Astronomy is indebted to Professor Hall, of the Naval Observatory, for recent important work on the six inner satellites of the planet *Saturn*. Excepting *Titan*, most of these satellites

are faint objects, and the ring increases the difficulty of making accurate observations, and so, for many years after the discovery of these satellites, their orbits were only rough approximations. Bessel published in the *Astronomische Nachrichten*, vols. 9 and 11, an orbit of *Titan* from which the mass of *Saturn* was determined, and this value has been commonly used in computing perturbations produced by this planet.

Before his death in 1846, the distinguished Bessel began (but did not complete) a memoir on the *Theorie des Saturns Systems*, which Professor Hall pronounces "the most complete investigation we have of the differential equations of this system, and of the various forms of the perturbative function arising from the figure of the planet, the Ring, the action of the satellites on each other, and the action on the sun." It was published in vol 28 of *Astronomische Nachrichten*, and in convenient form in Englemann's *Abhandlungen von F. W. Bessel*, vol. 1, p. 160. In Bessel's work, to determine the mass of the Ring from the motion of the line of apsides of the orbit of *Titan*, the figure of the planet was neglected, supposing its influence to be small. In order to separate the forces due to the Ring and the figure of the planet, M. Tisserand pointed out the necessity of determining the orbits of the other inner satellites, in vol. 1 of the *Annals l'Observatoire de Toulouse*, from which it appears that if these orbits are decidedly eccentric, so that the motion of their apsides may be accurately observed, the mass of the Ring and the figure of the planet may be found by comparison with theoretical expressions.

The first step in Professor Hall's work was to determine these orbits with as much accuracy as possible. *Titan* was observed at the oppositions of 1875-6-7 and also in 1883, and the other satellites chiefly within the same period by himself and Professor Newcomb.

In the paper before us, Professor Hall's summary of results is as follows: "From the observations thus far made at Washington, we have the remarkable result that the five inner satellites of *Saturn* move in orbits that are sensibly circular. This result, of course, sets aside all considerations of the motion of

their lines of apsides. It is probable also that these five inner satellites move in the plane of the Ring; at least so nearly that we may take this plane for the plane of their orbits in all calculations of their motions. The error of this assumption will certainly be very small. The mass of *Saturn* is found most accurately from *Japetus* and *Titan*, since very small errors of observation entering into the determinations of the mean distances of the inner satellites have a great influence on the value of the mass. The motion of *Titan* is so connected with that of *Hyperion* that a little doubt may arise from this source, but probably the mass of *Hyperion* is very small and the observations of *Titan* are well satisfied by pure elliptic motion. The mass of the planet has been computed from the elements that have been found for *Titan*, *Rhea*, *Dione* and *Tethys*. * * *

The mean result from the four satellites is therefore—

$$\text{Mass of } Saturn = \frac{1}{3478.7 \pm 1.10}$$

This is an increase of the mass of the planet amounting to nearly one sixteenth of itself over the value given by Newcomb and Holden.

Since the five inner satellites move nearly in the plane of the Ring, and also in circular orbits, it is easy to furnish tables of their motions, which, with the elements of the Ring, complete the paper.

SOME ACCOUNT OF A NEW CATALOGUE OF THE MAGNITUDE OF SOUTHERN STARS.

EDWIN F. SAWYER, CAMBRIDGE, MASS.

The present short paper is merely intended to announce the completion, in the immediate future, of a work undertaken in 1882, namely, the determination of the relative magnitude of the stars included between the equator and 30° S. Dec., and not fainter than the 7th magnitude. In fact the work is a revision of so much of Dr. Gould's valuable catalogue the Uranometria Argentina, as is included in the above limits, and his

catalogue has been used as the basis of the undertaking. The observations have been made by Argelander's well known method of step estimations; the stars being gathered into convenient sequences, and these sequences formed from the stars as closely adjacent as possible; thus reducing to a minimum errors arising from atmospheric causes and the unfavorable situation of the stars, except in a few sequences formed from bright stars necessarily more widely scattered. In making the observations, an opera-glass magnifying two and one-half diameters has been employed and the glass placed slightly out of focus, expanding the stars into disks of light; this method after repeated trials appearing to give the most reliable results, especially where the stars are colored. The observations have generally been made during evenings free from the moonlight and clouds and haze. As at first planned, each star was to have been observed but once (owing to the press of other astronomical work on our leisure time), but after the observations had been practically completed in 1885 (comprising some 3500 stars) and while their reduction was under way, it was decided to re-observe each star once in ordinary cases, repeatedly where large discordances appeared. This duplication of the observations, while it increased the amount of time and labor which I had originally intended to devote to the undertaking, would, I felt, be justified by the enhanced value of the results; observations were therefore resumed in 1886, and it is hoped that another year will find the work completed and ready for publication.

The number of stars comprised will approximate 3500, and the average number of observations for each star will be about three and one-half. During the progress of the work one variable star has been discovered, and large discordances in the observations of several stars may possibly lead to the detection of others.

As a test of the character of the work, the following results have been deduced from a partial discussion of the observations of about 900 stars observed from two to five times each.

To determine the accidental errors of observation, I have

found from 593 stars, observed twice, that the average difference between two independent determinations of a magnitude of a star is .112 of a magnitude, which corresponds to a probable error of a single observation of ±.065 of a magnitude. There appears to be no sensible difference in the values of this element dependent on the zenith distance.

The process of reduction adopted presumably excludes a liability to any systematic deviation from the system of magnitude of the Uranometria Argentina, which, as is known, is based on that of the Uranometria Nova. But a direct test has been made to verify this point, by employing stars observed three or more times. Taking the difference between my mean magnitude and that of Dr. Gould's, and classifying according to magnitude we have the following table:

Mag.	No. of Stars.	G.—S. Systematic Difference.	Probable Error of a Difference. G.—S.
1—4	49	—.033	±.106
4—5	46	—.004	±.109
5—6	59	+.017	±.083
6—7	98	+.002	±.073
	252		±.091

The values in the third column are merely nominal and afford satisfactory evidence of the coincidence between my magnitude scale and that of Dr. Gould's. From the fourth column, it appears as would naturally be expected that the estimates for the fainter magnitudes are ratably the more accurate. The probable error of a difference G.—S. is on the average .091 of a magnitude. Assuming for want of a criterion that both catalogues have equal weight, this corresponds to a probable error in each of .064 of a magnitude.

I have not limited the observations to the stars only contained in Dr. Gould's Catalogue, but have inserted all objects which have appeared to be in the neighborhood of his fainter class.

The number of such objects is surprisingly small, probably not over seventy-five; and this, in connection with the observed small probable error appears to be a most satisfactory evidence of the high degree of precision of the magnitudes of the Uranometria Argentina.—*Salem Press.*

PROVISIONAL VALUE OF THE LATITUDE OF THE LICK OBSERVATORY.

PROFESSOR GEORGE C. COMSTOCK.

The following provisional value of the latitude of the Lick Observatory depends upon observations made upon four nights in August, 1886, with the Repsold meridian circle by Professor George C. Comstock, assisted by President E. S. Holden, who kindly read the microscopes. All of the stars observed were selected from the star list of the *Berliner Astronomisches Jahrbuch*, and the latitude depends upon the apparent declinations of the stars as given in that ephemeris. Both the fixed and the movable circle of the instrument were read for each star, and were separately reduced. The discordances found between the results from the two circles are not greater than may fairly be attributed to division errors; the results from the fixed circle are, however, rather more accordant with each other than are those from the movable circle, indicating either inferior graduation or unstable clamping of the latter.

Each observed star furnishes a value of the reading of the circles when the telescope is pointed to the celestial equator (technically called an equator point), and the mean of all the equator points obtained during a night is taken as the equator point for that night. The circle reading corresponding to the nadir was obtained at the beginning and end of each night's observations, and the mean of these nadir points is assumed as the nadir point for the night. The agreement of the individual nadir points is fairly satisfactory, the difference between separate determinations upon the same night in no case amounting to as much as 1″. The difference between the mean

equator point and the mean nadir point is the supplement of the latitude.

The following table furnishes a brief summary of the results derived from the observations of each night :

Date.	Position of Instrument.	No. of Stars.	Latitude from Fixed Circle.	Latitude from Movable Circle.
1886—August 5.....	Clamp W.	7	37° 20′ 24.7″	37° 20′ 24.5″
August 8.....	" W.	12	24.2	25.1
August 13.....	" E.	8	25.3	24.8
August 14.....	" E.	11	25.3	25.4

The mean of the results Clamp W. is 37°20′24″.6 ; the mean for Clamp E. is 37°20′25″.2, showing a slight discordance between the results derived from different positions of the instrument. Such a discordance was *a priori* probable, having been found in the case of other meridian circles.

The most probable value of the latitude that can be derived from these observations, is the mean of the results Clamp W. and Clamp E.:

37° 20′ 24″.9,

which may be adopted as a provisional value for the latitude of the centre of the mercury basin of the meridian circle. The probable accidental error of this result, estimated from the discordances of the individual results, is not far from ±0.″10, but the above value of the latitude provisionally assumed, may be affected by systematic errors arising from defective graduation of the circles, flexure, irregular refraction, etc., amounting in the aggregate to a considerably greater quantity.

The north dome of the Lick Observatory is twenty-seven feet north of the meridian circle, whence its latitude results from these determinations, 37°20′25″.2.

Mr. C. A. Schott, Chief of the Computing Division of the U. S. Coast and Geodetic Survey, has kindly communicated results for the position of this station, which have been derived from the triangulation measures of Professor Davidson.

These are (for the dome of the 12-inch equatorial):

Latitude = + 37° 20′ 24″ .752.
Longitude = + 121° 38′ 35′ .284 (Greenwich).
Longitude = 8*h* 6*m* 34.352 (Greenwich).
Longitude = 2*h* 58*m* 22.26 (Washington).

It will be observed that our determination of the latitude gives a result, 0″.4 greater than that of the U. S. Coast Survey. This corresponds to about forty feet, six inches. The agreement between the two results is perfectly satisfactory, when we consider the small number of stars observed by us, and also that the position derived by the U. S. Coast and Geodetic Survey is not strictly definitive, as two stations (viz., Macho and Sta. Ana) require to be occupied to complete the primary triangulation in this vicinity.

ASTRONOMICAL THEMES IN LATE PERIODICALS.

Monthly Notices, No. 9, Vol. XLVI. Observations of the variable star R *Carinæ* from September, 1883, to April, 1886, by John Tebbut.

Observations of Calliope, by R. Luther.

Observations of Comets, 1877, I, II, III, VI; 1880, III; 1882, III; 1884, III, at Dun Echt Observatory, made with 15-inch refractor, with remarks and illustrations.

Observations of Comet of Fabry, 1885, Barnard, 1885 (*e*), c, 1886, and Brooks I, 1886, at Sydney Observatory with 11½-inch refractor.

Ephemerides of the Satellites of Saturn and the Satellite of Neptune for 1886 and 1887, by A. Marth. From observations at Malta in 1852 and 1864, Mr. Marth computed the orbit of the satellite of Neptune. In 1874, Professor Newcomb, and in 1883, Professor Hall, each published elements of the same orbit with the following results in regard to *inclination* and *Longitude of node on Neptune's orbit*:

		Long. of Node.	Incl. of two orbits.		
Malta,	1852	176.20°	148.33°	or 31.67	if the satellite's
	1864	180.41	146.19	33.81	motion is reck-
Washington,	1874	182.59	144.04	35.96	oned as retro-
	1883	184.31	142.38	37.62	grade.

The question is how are these figures to be explained? Are these changes in the position of the plane of the satellite's orbit by some disturbing force, or are these systematic errors of observation?

Mr. Marth properly suggests that large telescopes, with good micrometers may be profitably employed at the present opposition of Neptune in obtaining measures of position angle and distance.

In *l'Astronomie* (French), for November, the leading article is by the editor, Camille Flammarion, on *The Secular Movement of the Pole and the Solar System.* The motion of the pole of the earth about the pole of the ecliptic is described, in popular language, giving dates and principal stars which it passes in its revolution, its path being neatly shown by a large plate. The path of the pole is not a smooth curve as determined by the places of the stars, for they have proper motion, and the whole solar system is in motion also. This is also shown in the figure by a dotted curve line, indicating drift towards *Hercules.* When the celestial pole shall pass near *Vega*, 11,700 years hence, the real distance will be less than now supposed on account of the two reasons just given. The proper motion of *Vega* is A. R. + 0.0173*s.*, P. D. —0″.295; resultant 0″.359, amounting in 12,000 years to 1° 12′.

The path of precession has yet another cause of variation, due to the change in the obliquity of the ecliptic, its extreme range of oscillation being 2° 37′, which, however, is so slow as not to modify the curve sensibly, only very slightly diminishing it toward the centre.

The condition of the world at different epochs in the past is then noticed, followed by an imaginary prophecy for epochs in the future.

The second article is by Gustave Hermite on *The Determination of the Number of Stars of our Universe.* The stars are not innumerable. The unaided eye sees in the northern hemisphere, 2,478; in southern, 3,307. Opera-glass shows 20,000; small telescope, 150,000; large telescopes reveal 100,000,000. Apparent brightness or magnitude depends on (1) real size,

(2) intrinsic brightness, (3) distance. After speaking of variable stars, a half-page table is given, showing (1) different magnitudes from 1 to 20; (2) luminous intensity of each magnitude compared with the first; formula, $x=2.56$ with exponent $n-1$, n being corresponding order. For example, 6th magnitude would be 110 times less luminous than 1st; (3) gives number of stars belonging to each magnitude forming nearly a geometric series, with $r=3$; (4) contains numbers for each magnitude corresponding more nearly with results of observation obtained by another formula; (5) gives ratio for luminous intensity of each magnitude and (6) furnishes computed results. Then follows the statement of two laws:

1. The number of stars passing from one magnitude to the next follows an increasing geometrical progression whose first term is 19 and whose ratio is 3.

2. The total luminous intensity of the different magnitudes follows also in increasing geometrical progression whose first term is 19 and whose ratio is $\frac{8}{2.56}$.

These facts are well established; and yet the writer properly adds, that the terms of this increasing geometrical progression increase to infinity; but if the number of stars increase to infinity by the first law, the luminosity ought to increase in the same way according to the second law. It is claimed that the second law is arrested in its operation by a cause intimately connected with the constitution of our Universe.

Other articles of this issue of *l'Astronomie* are elsewhere noticed.

Astronomische Nachrichten, Nos. 2751, 2752. (German.) The leading article in No. 2751 is concerning the method of computing the curves of objectives according to Scheibner's new principles. The theoretical way of doing this work is given in detail, as well as some account of how the new method came to be published. The optician who has some knowledge of the mathematics will be interested in this paper, which he should read entire for a proper understanding of the method. Following this is a report from several prominent observers claiming that the great nebula of *Andromeda* was active again during

October 2-6, and that a star certainly as bright as a 10th or 10.5th magnitude was then observed in, or near, the place of the wonderful *nova* of last year. Herr N. von Konkoly, of Ogyalla, said that he saw the star without question on the 3d day of October. On the same day, the nebula was photographed by Herr Eugene von Gothard, of Hereny, and he found, on comparing it with a photograph of the *nova*, taken September 7, 1885, that the correspondence with the surrounding stars, and the new star with the *nova* of 1885, was perfect.

Other prominent observers, however, on examining the nebula later with more powerful telescopes saw nothing new or unusual; and some think that the observers first named must have mistaken a certain 11th magnitude star for the supposed new one. Drs. Englemann, Lamp, Krueger Schœnfeld, and Baron von Englehardt are satisfied that for several days near the middle of October, and so late as October 20, there was nothing unusual in the appearance of the nebula. These opinions are given in No. 2752 A. N., which also contains Dr. Lewis Swift's 4th Catalogue of new nebula discovered at Warner Observatory, Rochester, N. Y.

Gould's Astronomical Journal, No. 145. This publication is resumed again; first number of Vol. VII appeared November 2. It contains an article by S. C. Chandler *On the Light Variations of Sawyer's Variable in Vulpecula; A New Variable of Short Period*, by E. F. Sawyer, and part I of *Inequalities of the Moon's Motion produced by the Oblateness of the Earth*, by John N. Stockwell. Part I presents general considerations and history of the problem. Four points are made in the outset, the first three of which deal with the known principles of gravitation, and the last gives a brief history of the problem beginning at the middle of last century, with Meyer's co-efficient of inequality in longitude amounting to 4″, which Mason declared later should be 7.7″. In 1773, LaGrange first announced that the non-spheroidal form of the earth would affect the moon's motion, the amount of which Laplace found to be 6.8″ in longitude, if the oblateness of the earth be $1 \div 304.6$. Laplace's theory also revealed a more surprising in-

equality of 8″ in latitude which had been unnoticed before. In 1879 and later, Mr. Stockwell gave attention to the lunar theory, using a method of computation depending on the variation of the co-ordinates of the disturbed body, the results of which he attempted to verify by another common method, viz.: varying the elements of elliptical motion, but without success. The difficulty he could not explain. Later he found serious errors in his own work, and, as he supposed, in the solutions of other investigators also, notably that of Mr. Hill, of Washington. Attention was called to these errors in *The American Journal of Science*, February, 1885, in which Mr. Stockwell says (pp. 160, 161) that there are 374 inequalities of motion, and that not more than *two* of them, if indeed *any*, are acurate in Mr. Hill's *Supplement to Delauny*, chiefly because he has neglected three important terms in the development of his equations representing the disturbing forces. In the March *Observatory* (1886), Professor J. C. Adams claims that Mr. Stockwell's criticisms are not good, because the perturbations due to the earth's figure are very small compared with those due to the action of the sun, and therefore Mr. Hill's formulæ are sufficiently accurate. Mr. Stockwell is not satisfied to leave the discussion in this way and will continue it further.

Nature (October 14, 1886) has, for its frontispiece, a beautiful steel engraving of Professor J. C. Adams, Cambridge, England. Under the title "Scientific Worthies," will be found a sketch of the life of that distinguished scholar.

In *Nature* (October 28) Miss A. M. Clerke presents an extended review of Schulz's Solar Physics. Articles entitled "The New Optical Glass," and "The German Naval Observatory" also appear.

EDITORIAL NOTES.

This number completes Volume V of the MESSENGER, and with it expires a large number of subscriptions. Persons desiring its continuance will please say so by card or letter and thereby assist us in preventing irregularities by mailing.

FINLAY'S COMET (*e*, 1886). Professor Boss has computed a second orbit for Finlay's Comet, from four observations, giving decidedly elliptical elements. The period found is only 4.32 years. The inclination of the orbit being very small (3° nearly), the position of the node is uncertain. The comet is approaching the earth, and on December 1 it will be (theoretically) nearly twice as bright as it was November 1. At the present writing (November 20) its coma is about 4′ in diameter, with strong central condensation and no train. It is among the small stars of *Capricornus*, about 2° south by the ecliptic. December 3 the comet will pass very near *δ Capricorni*, its general path being nearly northeast.

RECENT SHOWERS OF METEORS.—I send the following in continuation of the results already published in the SIDEREAL MESSENGER, December, 1885, p. 300 and February, 1886, p. 61.

Between the end of April, 1886, and the beginning of November, I recorded 958 shooting stars during watches covering a total of 119 hours. I have made the following selections from the radiant points derived from these observations. The *Perseids* have been omitted as already sufficiently investigated:

Epoch of Shower.	Night of Max.	Radiant Point. R. A.	Dec.	No. of Meteors.	Appearance.
1886.		°	°		
April 27—May 5	May 5	234	+ 10	8	Swift.
April 30—May 6	May 6	337	— 2½	11	Rather swift. Streaks. Long.
April 30—May 7	May 5	254	— 21	5	Slow, long paths.
May 1—4	May 1	239	+ 46	8	Rather swift, short and faint.
May 29—June 4	May 29	333	+ 27	4	Swift. Streaks.
June 26—July 6	July 1	294	+ 39	9	Slow, short.
July 27—Aug. 11	Aug. 2	291	+ 51	14	Rather slow, short.
July 30—Aug. 11	Aug. 4	350	+ 51	11	Swift, short.
July 31—Aug. 4	July 31	20	+ 57	7	Swift, streaks.
August 2—10	Aug. 4	48	+ 43	10	Swift, streaks.
August 4—10	Aug. 4	26	+ 42	6	Swift, streaks.
August 22—28	Aug. 22	331	+ 71	8	Swift, short.
August 22—29	Aug. 29	292	+ 70	11	Swift, bright.
August 29	Aug. 29	106	+ 52	6	Rather swift.
September 21—22	Sept. 21	63	+ 21	7	Swift, streaks (1879-86).
September 22—27	Sept. 27	115	+ 52	7	Swift, streaks.
September 22—30	Sept. 27	14	+ 12	8	Slowish bright.
September 22—30	Sept. 22	292	+ 71	10	Swift.
September 27	Sept. 27	75	+ 15	8	Very swift. Streaks.
September 30—Oct. 2	Oct. 2	73	+ 41	7	Swift, streaks.
October 22	Oct. 22	43	+ 5	5	Slow, faint.
November 2—3	Nov. 2	55	+ 9	17	Slowish, trained, bright.

Bristol, England, Nov. 5, 1886. W. F. DENNING.

ANNALS, VOL. XVI, H. C. O.—Volume XVI of the Annals of the astronomical observatory of Harvard College has been distributed It contains observations of fundamental stars made with the meridian circle during the years 1870 to 1886, and prepared for publication under the direction of Joseph Winlock and Edward C. Pickering, by William A. Rogers.

The introduction to this volume should have special mention because of the full explanations given under the heads of reductions in right ascension and declination and illustrative examples of the methods ; tabular values of the coefficient of collimation constant; investigation of the homogenious character of the value of a certain constant called n; flexure constant, its variability, and, as a function of the sine of the zenith distance; reduction of the equator point; reduction of the mean of two to the mean of four microscopes, and many more points of as much value to those especially interested in meridian circle places as those already named. It is work of the highest order.

COMET OF BARNARD.—The comet discovered here on the morning of October 5, has been regularly observed when the weather permitted. On the morning of October 30, it had so increased in brightness as to become visible to the naked eye, as a hazy spot, as bright as a sixth magnitude star. The same morning I suspected that the broad brush-like tail was bifurcated and on the morning of November 1, I readily detected two tails, the longest being at a position-angle of (by estimation) 287°, and was about 2½° long, while the second tail at a position-angle of 134° was somewhat less than ½° long. Evidence of the formation of a third tail was visible at a position-angle of 150°.

They were both distinct but somewhat faint, and the sky between them was free of nebulous matter, showing that their tails were entirely distinct from each other. Both tails, at subsequent observations, were found to be brighter and increasing in length. At the last observation, before the present moon interfered, the comet was quite noticeable to the naked

eye, fully as bright as a fifth magnitude star, and traces of the tail were beginning to be apparent without the telescope. November 15 in nearly full moonlight, the comet could be seen without the telescope, a short distance above *Epsilon Virginis*. Vanderbilt University Obs'y, Nov. 18, '86. E. E. BARNARD.

BARNARD'S COMET (*f* 1886).—From three observations of Barnard's Comet (*f* 1886) I have derived the following system of elements:

$$
\begin{aligned}
T &= \text{Dec. } 18.0335 \ G.\ M.\ T. \\
\omega &= 85^\circ\ 00'\ 40'' \\
\Omega &= 137\ \ 58\ \ 04 \\
\pi &= 52\ \ 57\ \ 24 \\
i &= 80\ \ 01\ \ 29 \\
\log q &= 9.839356.
\end{aligned}
\qquad \text{Mean Eq. } 1886.0
$$

Motion retrograde.

$$
\begin{aligned}
x &= 9.876084\, r\,(3^\circ\ 53'\ 10'' + v) \\
y &= 9.827726\, r\,(199^\circ\ 02'\ 45'' + v) \\
z &= 9.996166\, r\,(100^\circ\ 36'\ 20'' + v)
\end{aligned}
$$

The geocentric path of this comet will be above the western horizon in December and January, and there is a probability that the body itself will become visible to the naked eye about the middle of next month; but if it does not, there is almost a certainty that it may be seen easily by those who possess even very ordinary telescopic aids.

Washington, D. C., November 17, 1886. S. J. CORRIGAN.

PARALLAX OF *a* LYRÆ AND 61 CYGNI.—In 1882 Professor Hall, Naval Observatory, Washington, D. C., published his observations made with the filar micrometer of the 26-inch equatorial for determining the annual parallax of the stars *a Lyræ* and 61 *Cygni*. The results then obtained were:

$$\pi = 0.1797'' \pm 0.005612, \text{ for } a\ Lyræ.$$

$$\pi = 0.4783'' \pm 0.01381, \text{ for } 61\ Cygni.$$

making the distances of the two stars, respectively 18.11 and 6.803 Julian years, as measured by the velocity of light. The

observtaions from which these results came were the differences of declination of the principal stars, with respect to small ones near them, supposed to have no physical connection. Professor Hall suspected something wrong in the process of reduction at the time and Dr. Peters later observed that the correction for temperature had been applied with the wrong sign. From 1883 to 1886 further observations of these stars and 40 *Eridani* and 6 B *Cygni* were made with a 26-inch equatorial, but preceding their reduction, a full discussion of the value of the arc of one revolution of the micrometer screw is given in Professor Hall's paper on the fuller study of the parallax of these stars recently published. The following table gives the summary of results as found in that paper:

Date.	Star.	Parallax.	No. of Obs.
Feb. 23, 1883, to March 4, 1884	40 Eridani	+0.223″ ± 0.0202″	30
July 31, 1883, to April 15, 1886	6 B Cygni	—0.021 ± 9.0077	54
May 24, 1880 to July 2, 1881	a Lyræ	+0.134 ± 0.0055	128
Oct. 24, 1880, to Jan. 26, 1886	61 Cygni	+0.270 ± 0.0101	101

The change in parallax of the last two stars is very considerable, and, of course, makes a corresponding change in distance from our sun. While we have recently thought of light reaching us from 61 *Cygni* in 6.8 Julian years, we must now wait for it 11.8 years. The light-distance of *a Lyræ* is also increased from 18.1 to 24.3 Julian years.

Professor Hall's paper is good reading for variety of method in finding the value of one revolution of the micrometer screw.

THE SIDEREAL DAY.—In the October number of *l'Astronomie* (French), H. Rapin discusses the sidereal day and the rotation of the earth on its axis. After speaking of the diurnal, annual and precessional motions of the earth, he claims that the first is not accurately defined in text-books and works on astronomy because the effect of precession is not considered; that when a meridian of the earth, in its daily rotation, comes

a second time to the equinox, it has then described 360°; that the earth's arc of rotation, as limited by the successive culminations of a star absolutely fixed in space, is more than 360° by the small amount of .008 of a second of time and that the ordinary definitions of the sidereal day do not distinguish between these two periods.

He criticizes the common definition of the sidereal day in the following language:

"We find fault with these definitions

1. Because they present as absolute and general and without qualifying words an identity which does not exist, and can be assumed as true only for short periods of time.

2. Because they call that sidereal which is so only by practical necessity, and which is really equinoctial or tropical.

3. We wish that the books for instruction, including the practical, contained a short article to make this point clear and prevent false ideas."

CATALOGUE OF 1213 STARS.—The catalogue of 1213 stars by Professor W. A. Rodgers, of Harvard College Observatory, has recently been published. It contains the annual results for the fundamental stars during the years 1870-1879; results for the separate observations of the same stars during the years 1883-1886, in the form of corrections to the places obtained by previous observations and results for the separate observations of various other classes of stars particularly described in the introduction.

This catalogue of 1213 stars was fully explained in a publication under the above title which was issued in 1884.

AUGUST ECLIPSE PHOTOGRAPHED.—Mr. R. D. Schimpff of Scranton, Pa., photographed the partial eclipse of August 29, 1886, at 6^h 18^m A. M., with a 3-inch refracting telescope. The copy sent the MESSENGER is beautifully clear and definite. Mr. Schimpff says: "The fogs at that early hour obscured all the detail upon the solor disc; also, prevented delicate spectrocopic examination which I intended to make."

EDINBURGH OBSERVATIONS, VOL. XV.—This star-place catalogue and ephemeris for 1830 to 1890 contains astronomical observations for 1878 to 1886, made at the Royal Observatory at Edinburgh, under the direction of Professor C. Piazzi Smyth, Astronomer Royal for Scotland. Volume XIV, which was published in 1877, is part of this catalogue and has star numbers to 641 in the consecutive count with this volume designated XV. The preceding volume covers only the first four hours of right ascension, while this embraces the remaining eighteen hours, making a large book of 1675 large pages with 3890 consecutive star numbers.

In this catalogue each page is ruled into seventeen vertical columns. The first gives its own consecutive star number; the second, name and number in the British Association catalogue, history, and, if a double star, the brighter component observed when definitely possible; third, observed or tabular magnitude; fourth, date of right ascension observations; fifth, year reduced to, by observer and editor of catalogue; sixth, mean right ascension on January 1 of the year referred to, observed, (tabular); seventh, number, and name of observer, and correction to tabular place at date; eight, nine, precession in right ascension; ten, annual proper motion; eleven, date of north polar distance; twelve, reduction; thirteen, fourteen, fifteen, sixteen and seventeen, treat north polar distance similar to right ascension.

Three or four stars only occupy one page, in consequence of the varied and comprehensive data presented. (Professor Smyth calls our attention to one correction that should be made on page 642, column 17, and line 4. For R. Asc. read N. P. D.)

The preparations of this catalogue has required an immense amount of labor, which, doubtless, has been carried forward with the skill and care for which the Astronomer Royal of Scotland is well known during forty years of useful and distinguished astronomical work.

This catalogue will be heartily welcomed by star observers on this side of the water.

PHOTOGRAPHY OF THE HEAVENS.—The marked success of the observers, Paul and Prosper Henry, at the Paris Observatory, in celestial photography recently, is worthy of the general and favorable notice it is receiving. The instrument used consists of two telescopes, side by side; one objective being 9.4-inches aperture, and 11ft. 10 in. focal length, used as a pointer, the other 13 4 inches aperture, and 11ft. 3 in. focal length, and corrected for photographic rays. The latter objective consisting of a single lens has a field of 3° in diameter. In the first trials of the new instrument, on a surface of five degrees square, the sensitive plate showed 2,790 stars, between the fifth and fourteenth magnitudes with unmistakeable clearness.

Stars of the fourteenth magnitude appear on the plate as $\frac{1}{1000}$ of an inch in diameter and require an exposure of the plate for one hour. The clock-work that will keep an instrument so steadily in motion for so long a time as is necessary to photograph stars of the fourteenth magnitude must have a control of marvelous precision.

The photographic plate is manifestly more sensitive than the retina of the eye, and hence it can be used in discovering and mapping the asteroids, in the examination of double and multiple stars, and in the study of the colors of the stars.

LEANDER MCCORMICK OBSERVATORY.—The report of the Director, Professor Ormond Stone, to the Board of Visitors, shows that the great 26-inch equatorial has been chiefly employed in studying the southern nebulæ. The nebula of *Orion*, the Trifid and Omega nebulæ have received special attention. Two hundred and thirty-three new nebulæ have been found, three hundred and fifty-one observations of miscellaneous ones have been made resulting in two hundred and twenty-six drawings. Some work has been done on difficult double stars and Barnard's comets, (1885 II and 1886) and Tuttle's periodic comet were observed. Part 3 of volume I of the publications of the Observatory has also appeared. Its subject matter is the nebula of *Orion*, 1885, and is a detailed statement of the notes and observations of Professor Stone and Mr. Leavenworth, his

assistant, from January 12 to March 18. The notes are accompanied by drawings and finely executed plates of the nebula as a whole.

BRIGHT METEOR.—While returning to town with Rev. J. E. Garrett, on Sunday evening, October 24, at about 11 o'clock, Washington, D. C., time, I saw an unusually large and bright meteor. When first seen, it was in the neighborhood of the *Pleiades*, and it disappeared in the neighborhood of μ *Cassiopea*. I think it must have been visible much further to the southeast than the *Pleiades*, as it was light enough to see the telegraph wires distinctly as I looked up, although there was no moon and the stars were faint. It was quite a brilliant object, almost terrifying in its vividness. I cannot give the exact time, as I had no means of making a light to consult my watch, but the time given is not many minutes wrong.

Washington, Ohio, Oct. 25, 1886. W. R. SCOTT.

A NEW OBSERVATORY IN LA PLATA.—We are glad to learn that the government of La Plata are fitting out an observatory in the Province of Buenos Ares. If supplied as liberally with good workers as with instruments we may expect soon to have some good work done here. Among the numerous instruments are a telescope (reflector) 31·5 inches in diameter, an equatorial coude 17 inches aperture, an 8-inch transit, an alt-azimuth, an apparatus for celestial photography, a large Thollon spectroscope, 9·8-inch objective, numerous geodetic instruments, including three portable transits, a set of magnetic instruments, and finally fourteen collections of meteorological instruments, to be distributed over the district. The optical portion of these instruments is to be constructed by MM. Henry of Paris. A time service is to be instituted. The observatory is to be under the direction of M. Beuf, late an officer in the French navy. It would seem that a large amount of geodetic work is to be done, including the measurement of an arc of a meridian, for which the immense plains of Chaco and Patagonia are extremely favourable.—*Observatory*.

OBSERVATIONS OF METEORS.—On the evening of the 4th inst., while endeavoring to observe the variables, R. and S. *Tauri*, a few degrees south of the *Hyades*, at about 9*h* 47*m* standard time, with a 6-inch telescope, power 45, the field of view was suddenly filled with a blaze of bluish light. Quickly withdrawing my eye from the glass, I saw a very brilliant meteor just before its disappearance, and which had passed within two or three degrees of the neighborhood I had been examining. It left a bright trail which remained visible to the naked eye for three or four minutes, and through the telescope for as much longer. With the glass it appeared as a long sinuous mass of luminous vapor, being almost curled up in itself in one place. The whole having a very perceptible drift towards the southeast. The length of the trail was about 8 degrees, extending from neighborhood Σ 495, past 57 *Tauri* and ending about midway between 88 and 95 *Tauri*, as traced on Proctor's atlas. It could probably have been traced much further had it not been for the presence of the moon then at first quarter.

It was the brightest meteor I have seen in a long time. It was sufficiently luminous to cast a shadow almost at right angles to the rays of the moon. On the same evening, some other meteors, but much fainter, were noticed dropping down in the east and northeast, in paths nearly parallel to above. Also on the 1st inst., several were seen in the same portions of the heavens, between eight and nine o'clock, falling in same general direction, some of these being as bright as first magnitude stars. Again on the evening of the 5th inst. a member of my family noticed quite a brilliant one, which he described as shooting downwards and not very far from the position of the one of the previous evening.

These apparently came from direction of *Aries* or *Andromeda* but I cannot speak positively of this.

Bayonne, N. Y., Nov. 7, 1886. JOHN H. EADIE.

COMET *b*. (BROOKS) 1886.—The elements of Comet *b*, by Professor Frisby, given in June MESSENGER, made $i = 100°57.4'$; i should have been $100°21.0'$.

THE NEW STAR IN ORION.—My photometric measures of Gore's new star in the club of *Orion*, made it last December, 6.2mag.; and it gradually diminished to 10.0 mag. by April, when it was lost from the sun's proximity. In October it was somewhat brighter, 9.2 ; and now it is nearly as bright as at first, 6.8. I am not aware that a new star has ever before been observed to return to its original brightness. It has either disappeared utterly and finally, or gone to its lowest point and there remained without material change. It it hardly possible that this star can have been a variable, rising to nearly the 6 magnitude at its maximum, long before Gore's discovery ; and it remains to be seen whether it will now assume that character.

New York, November 22, 1886. HENRY M. PARKHURST.

THE LICK PHOTOGRAPHIC LENS.—Some time ago, it was decided by the Lick Observatory management to procure an additional lens for the great equatorial for the purpose of photography. The glass disc was obtained from Paris and given to Clark & Sons to work. While being ground it burst in pieces. Because of strong polarization at the edges indicating powerful strain, the Clarks knew, from the outset, that the disc was seriously imperfect, and would not assume the responsibility of working it ; so the loss falls on Feil & Son of Paris. Another will doubtless soon be furnished.

NEW MINOR PLANET was discovered by Dr. Palisa, October 3. 4836. Gr. M. T. in R. A. $23^h\ 3^m\ 17.4^s$, Declination 6°42′46″ and of fourteenth magnitude, its *number* being (260).

New Minor Planet (261) was discovered by Dr. Peters, October 31.79 Gr. M. T., R. A.=25°0′0″; P. D.=85°30′49″.

New minor Planets (262) and (263) were discovered by Palisa November 3, and are each of the twelfth magnitude. Their places respectively were :

R. A.$=12^h\ 39.7^m$; P. D.=75°57′43″.
R. A.$=12^h\ 56.0^m$: P. D.=76°13′25″.

The title to plate No. 3 in Essay on Red Light October issue should have been "Prismatic Halo, Nov. 20, 1885, photographed by H. C. Maine."

LIVERPOOL ASTR. SOCIETY.—Gore's *Nova* (1885) *Orionis* was observed here last night (Sept. 14th) and found to have a magnitude of 9.2. The star is very red. The small comes F was estimated as of 9.7 magnitude. T. E. ESPIN.

BOOK NOTICES.

Examples of Differential Equations, with Rules for their solution. By George A. Osborn, S. B., Professor of Mathematics in the Massachusetts Institue of Technology, Boston. Ginn & Company, Publishers, 1886, pp. 50.

This book was prepared to meet a want felt by the author in a practical course of Physics for advanced students, and is to be used in connection with a course of lectures on the theory of differential equations and methods for their solution. The topics treated are: Derivation of the differential equation from the complete primitive; differential equations of the first order and degree between two variables; exact differential equations—integrating factors; differential equations of the first order and higher degrees; singular solutions, linear differential equations; special forms of differential equations of higher degrees; simultaneous differential equations and geometrical applications.

The author has done real service for those teachers who wish to apply the Calculus to ordinary practical uses in the scientific school, and who have time to instruct students only so far in the uses of the differential equation. His 50 pages of matter gives the pith of Boole's larger work on the same subject containing nearly 500 pages.

SEDGWICK AND WILSON'S GENERAL BIOLOGY.—The American science series, published by Messrs. Henry Holt & Co., is constantly receiving important additions. This most recent contribution furnishes what was much needed, an introduction to the general facts concerning "matter in the living state."

The number of labratory manuals is already considerable and they all have commendable features. This book is more than a manual. It presents and discusses fully and admirably the facts and deductions which the study of the organisms illustrates. It is doubtless true that a stronger grasp upon a subject is gained when it is possible to bring the student to just conclusions from his own observations. This is impracticable and wasteful in many cases and resort must be had to direct presention enforced by carefully choosen illustrative examples.

This book will be welcomed by many who have been trying under unfavorable circumstances, to carry on instruction in this line. It furnishes much in excellent shape, which, heretofore, it has been necessary to give by lecture. This will leave more time for that thorough study of the illustrations which is needful to satisfactory results. Even those, who may dissent from the form in which some doctrines are presented, will find the volume helpful. L. W. C. JR.

Carleton College.

ARTHUR, BARNES AND COULTER'S PLANT DISSECTION.—Although published first, this work forms a supplement to the General Biology along the plant branch of the subject.

The illustrative plants are well chosen, being all easily accessible, and with, perhaps, a single exception, perfectly typical.

A term's use of the manual in the labratory shows that it has one essential feature of such a work, perfect clearness of statement. The ordinarily intelligent student can, with scarcely any assistance, follow the directions with success and profit. The directions for manipulations have proved of decided value, rendering unnecessary much personal attention and instruction.

The annotations, which conclude each topic, are well suited to impress the important points and stimulate to further investigation.

Good results , both in the way of general facts and familiarity with special structures, must follow the careful use of this manual. L. W. C. JR.

Carleton College.

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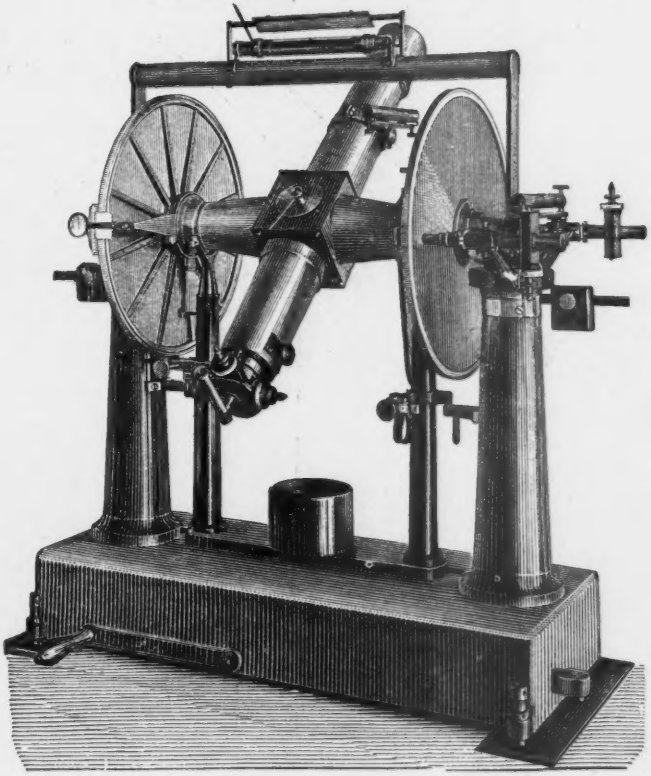

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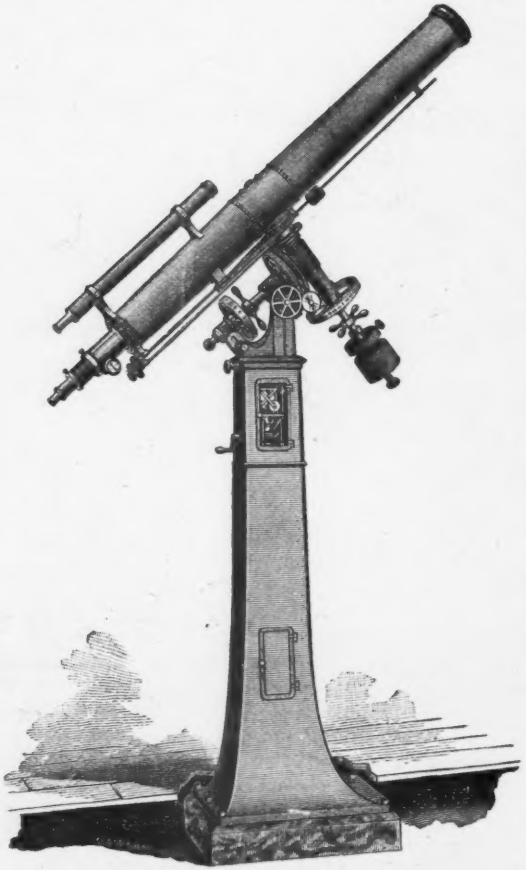

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